

were ordered: 22d, 9.50 a. m., storm northeast from Breakwater to Woods Holl section.

XI.—On the 18th pressure fell in Washington and British Columbia in connection with the trough stretching southward to the Gulf of California; this was followed by a rise on the 19th, while the lowest pressure developed in Alberta. By the 20th, p. m., low pressure extended from Alberta north to Athabasca, south to Montana, and east over Assiniboia, and by the 21st, p. m., was central in Manitoba. During the 22d, while this depression was extending eastward, the barometer again fell in British Columbia and the map of the 23d, p. m., shows two depressions, Nos. XI and XII, central, respectively, in Manitoba and Alberta. Low No. XI kept far to the north of our stations and disappeared on the 25th, p. m., in Labrador.

XII.—On the 23d, a. m., pressure was falling in British Columbia and the map of the 23d, p. m., shows that a depression must have existed in that region which, on the 24th, p. m., was central in Alberta. During the 25th, this depression stretched rapidly southward along the entire eastern Rocky Mountain slope and the Missouri Valley, and on the 25th, p. m., was central in Saskatchewan, while high pressure (30.20), No. V, was off the coast of Oregon and a similar high pressure was off the Carolina coast. By the 26th, a. m., this general depression had divided into three cyclonic regions, respectively, in Manitoba, South Dakota, and Arizona, of which the latter was the least perfectly developed and has already been mentioned under low No. I. The principal

depression in South Dakota was attended with high winds which were remarkably hot from Texas to Illinois, Wisconsin, and Minnesota, as also in Arizona; these hot winds continued during the 27th, but diminished somewhat on the 28th and 29th; the sky was generally clear and the air dry, only a few local rains being reported; the high temperature must be attributed principally to the dynamic heating of the air that flowed down and into the central depression from the high area over the Atlantic States and ocean to the eastward. From the 26th, a. m., to the 28th, a. m., the central low pressure gradually filled up and, after stretching as a trough from New Mexico to Lake Superior on the 27th, it had disappeared by the 28th, leaving areas of low pressure in Arizona, Assiniboia, and at the mouth of the St. Lawrence as remnants of the general depression that had previously existed.

In connection with low area No. XII the following signals were ordered: 25th, 10 p. m., storm southeast, lakes Superior and Michigan; 26th, 10 a. m., storm southeast, Sault Ste. Marie and Lake Huron; 26th, 10 p. m., storm southeast, continue on lakes Superior and Michigan.

XIII.—This number is given to the depression in Assiniboia just referred to as a remnant of low No. XII. By the 29th, p. m., pressure had generally fallen in Alberta and Assiniboia, and the depression continued to develop during the 30th and 31st moving, at the same time, slowly south-eastward while the barometer also fell at Yuma, so that on the 31st, p. m., depressions were central in Minnesota and Arizona, but without well-marked cyclonic winds.

NORTH ATLANTIC METEOROLOGY.

[Pressure in inches and millimeters; wind-force by Beaufort scale.]

NORMAL CONDITIONS.

The normal barometric pressure for July over the North Atlantic Ocean, as deduced from international simultaneous meteorological observations taken at Greenwich noon and not reduced to standard gravity, is highest, 30.25 (769), over an oval extending between N. 28° and N. 40° and W. 21° and W. 34°. A similar area of high pressure prevails on the Pacific Ocean between N. 40° and N. 20° and west of W. 135°; from this Pacific area a narrow prolongation extends northeastward to Vancouver Island, giving high pressures to the coast of Oregon and British Columbia. The area of low pressure characteristic of the North Atlantic during the winter months moves northward or northeastward during May and June, while the corresponding low area characteristic of Bering Sea moves northwestward during those months, so that the normal average for July shows these to have combined in one region of low pressure covering the Arctic Ocean and closely adjoining the Asiatic and Himalayan low pressures.

As compared with June, the normal pressures for July are higher throughout the United States, but lower throughout the British provinces, Greenland, Alaska, and the Arctic regions and nearly all of Asia; the pressures are higher in the Aleutian Islands, the United States, Mexico, and the northern central portion of Siberia. During this month the diminution of pressure that has been going on in the Arctic regions ceases and soon becomes converted into a rise, indicating a change from summer to winter conditions.

The normal zone of maximum frequency of tracks of centers of low pressure during the month of July passes from the southern part of the China Sea, near Borneo, northeastward along the coast of China and Corea over the Japan Sea, the Island of Jesso, south of Kamchatka into Bering Sea, thence east and southeast into British Columbia and eastward over Lake Superior and Newfoundland, thence east-northeast

to northern Norway and Sweden and southeast into the interior of Russia. These storm tracks thus circulate along the isobars of 29.80 to 29.90 that surround the low pressure of Asia and the Arctic regions; they represent the paths pursued by cyclonic eddies of air overflowing from the so-called areas of high pressure into the greatly distorted polar depression of the Northern Hemisphere. The number of such cyclonic whirls is probably not much smaller in July than in December, but the severity of the surface winds is very generally less, and therefore, the number of recorded storms is less. The greatest so-called storm frequency for the United States occurs in the winter months, but the chart showing the actual number of storm tracks passing over each square degree annually shows that a region of maximum frequency of from 40 to 50 storm centers per 5° square per ten years always exists, and that local variations in storm frequency depend upon comparatively slight changes in the location of the maximum region. Therefore, in so far as the existence and movement of cyclonic centers are an index to the general circulation of the atmosphere we should conclude that this is nearly uniform from month to month.

The normal rate of progress of storm centers during July is 25 miles per hour in the United States; 19 in the North Atlantic Ocean; 17 in Europe; 20 in the China and Japan seas; 23 in Bering Sea; the average for storms moving easterly is 21 miles per hour; the average of storms near the tropics moving westerly is given as 22 miles per hour.

NORTH ATLANTIC STORMS.

The following paragraphs give some account of the areas of low pressure and strong winds on the North Atlantic Ocean during July, 1894. Daily charts are compiled at the Weather Bureau showing the atmospheric conditions over the United States, Europe, and the Atlantic Ocean, as nearly as practicable at Greenwich noon, and afford a basis for approximating

the locations and paths of the more important areas of high and low pressure.

A. This was a continuation of low area *F* from the North Atlantic series for June. It was central on the 1st at N. 55°, W. 27°, while an area of high pressure prevailed over Europe. It moved slowly northward and then northeast, as a slight depression, without severe winds, and is not recognizable, owing to the want of data, after this date.

B. This was apparently a continuation of No. XX of the U. S. series for June, being central in Labrador on the 1st. Having passed eastward it seems to have joined the preceding depression, A, and the two together, on July 3 and 4, covered the area between Greenland and the Faroe Islands. By the 5th, noon, this had contracted to a small trough, central at N. 58°, W. 28°, after which it disappeared from our maps.

C. This was a continuation of No. IV of the U. S. series for July, which passed over Labrador on the 4th and was central on the northeast coast of Labrador on the 6th, noon. This depression appears to have passed over the southern end of Greenland, and may be identical with that which, on the 8th, was central south of Iceland, in N. 62°, W. 15°. During these days an area of high pressure continued over Europe, stretching from Italy to Norway, with gentle, variable surface winds. The reports from the Wellman Expedition show that, at this time, unusual cold weather was experienced in Spitzbergen, and the balloon ascensions made for meteorological purposes at Berlin, July 6 and 7, show that a layer of very cold air (temperature -50° to -55° C., -58° to -67° F., at an altitude of from 14,000 to 17,000 meters, 45,932 to 55,774 feet) was slowly descending upon Europe. Evidently there was going on at this time an outflow of cold air from the upper regions of the tropical Atlantic northeastward over Europe corresponding to the similar flow from the tropical Pacific northeastward into British America. From the 8th to the 10th the low pressure, C, stretched southeastward and became a trough extending over Ireland and southwestern England, after which it returned to its oval shape and on the 12th was central at N. 60°, E. 3°; it then again stretched northward and on the 15th passed eastward into Norway and Sweden, where it was central on the 16th, after which it was joined by the following area, D.

D. This depression appeared in Alberta and Montana on the 9th as No. VI of the U. S. series; it passed over Lake Superior on the 12th, Labrador on the 18th, and reappeared on the 14th, noon, off the coast of Labrador, at N. 53°, W. 49°. Its center was approximately N. 56°, W. 35° on the 15th, N. 60°, W. 15° on the 16th, and N. 51°, W. 12° on the 17th. After this areas C and D merged into each other and, on the 18th, covered southern Norway, being central at N. 62°, E. 8°. During the 19th, 20th, and 21st pressure remained low in Scandinavia and Finland, and several minor centers of low pressure developed in Europe.

E. No important cyclonic whirl appeared on the Atlantic south of N. 60°, after the passage of the preceding area, until the 24th, and, in fact, no wind force exceeding 8, on the Beaufort scale, was reported during the whole month. On the 23d, noon, a depression was apparently central at N. 54°, W. 48°; and on the 24th, noon, at N. 60°, W. 32°. No further location can be given for this depression, and it probably died away within a few days.

F. On the 27th, noon, a depression was central southeast of Labrador, probably a continuation of low No. XI of the U. S. series for July; this was central on the 28th at N. 52°, W. 32°, after which it disappeared, but a small whirl, which formed at its southeastern end, remained over the 29th and was central on the 31st at N. 55°, W. 20°.

LOW PRESSURES IN THE CARIBBEAN SEA.

The general equatorial belt of low pressure on the Pacific

coast of Mexico, Central America, and the northern portion of South America has several times during this month, and especially from the 9th to the 17th, been unusually well marked, giving rise to the appearance of local whirls and storms in the southern portion of the Caribbean Sea, but no extensive storm has developed from this condition. Throughout the West Indies the easterly trade winds have continued steady and the consequent necessary uplift of air in our south Atlantic States and on the eastern slope of the Cordilleras of Mexico and Central America appears to have given rise to an unusually heavy rainfall.

The observer at Santiago de Cuba, Mr. Rafael Inguera, communicates an extract describing the destruction done by torrential rains in the mountainous region of Prieto, situated to the southeast of the city of Saltillo, some time before the 23d of July. This is undoubtedly a part of the system of heavy rains that have caused the destructive floods in the Rio Grande and eastern Texas during July and August. These floods are probably intimately dependent upon the area of high pressure that has prevailed over the United States and the corresponding outflow of air toward the low pressure of the Gulf of California and Pacific coast of Mexico.

OCEAN FOG FOR JULY, 1894.

The limits of fog belts west of the fortieth meridian, as reported by shipmasters, are shown on Chart I by dotted shading. Near the Grand Banks of Newfoundland fog was reported on 26 dates; between the fifty-fifth and sixty-fifth meridians on 14 dates; and west of the sixty-fifth meridian on 17 dates. Compared with the corresponding month of the last six years, the dates of occurrence of fog east of the fifty-fifth meridian numbered the same as the average; between the fifty-fifth and sixty-fifth meridians, 5 less than the average; and west of the sixty-fifth meridian, 6 more than the average.

OCEAN ICE IN JULY, 1894.

The limits of the region within which icebergs or field ice were reported for July, 1894, are shown on Chart I by crosses.

The southernmost ice reported, an iceberg on the 1st in the position given, was about 14° south of the average southern limit of ice for July. The easternmost ice reported, a berg on the 7th about 100 feet high and 500 feet long in the position given in the table, was about three-fourths of a degree east of the average eastern limit of ice for July. The ice reported was distributed over the Grand Banks, off the eastern coast of Newfoundland, and in and east of the Straits of Belle Isle.

The following table shows the southern and eastern limits of the regions within which icebergs or field ice were reported for July during the last twelve years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Long. W.	Month.	Lat. N.	Long. W.
July, 1883.....	42 42	49 57	July, 1883.....	46 47	45 44
July, 1884.....	46 24	50 02	July, 1884.....	48 30	46 28
July, 1885.....	42 14	48 30	July, 1885.....	48 00	44 00
July, 1886.....	42 59	49 15	July, 1886.....	45 52	34 30
July, 1887.....	43 30	50 05	July, 1887.....	52 04	41 16
July, 1888.....	46 30	54 00	July, 1888.....	47 40	50 10
July, 1889.....	44 49	47 45	July, 1889.....	45 50	40 00
July, 1890.....	41 25	47 30	July, 1890.....	50 08	38 45
July, 1891.....	43 16	49 45	July, 1891.....	47 02	48 00
July, 1892.....	43 04	50 17	July, 1892.....	48 00	44 40
July, 1893.....	41 40	50 03	July, 1893.....	46 10	42 20
July, 1894.....	42 14	48 57	July, 1894.....	47 32	43 00
Mean.....	43 13	49 41	Mean.....	47 48	43 14

* An iceberg and field ice.

† On the 10th a small block of ice was reported in N. 46° 33', W. 24° 11'.